

**Key to North and Central American Species of the Mealybug
Genus *Hypogeococcus* (Homoptera: Coccoidea: Pseudococcidae)
with Descriptions of Four New Species and
Redescription of the Type Species**

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I wish to express my gratitude to Dick and Margaret Bohart for their unselfish efforts in my behalf while I attended the University of California at Davis. I take great pleasure in dedicating this article to them as a token of my sincere appreciation for their guidance, example, and many kindnesses.

INTRODUCTION

The genus *Hypogeococcus* was described by George Rau in 1938 and included only *H. barbarae* Rau. Ferris (1953) included a second species, and later three more were added to the genus (Miller and McKenzie, 1971; Williams, 1973; Willink, 1981). In this paper four additional species are described, and the type species is redescribed.

Hypogeococcus is known in the New World only and occurs from New York to Argentina. Species have been collected on such diverse hosts as composites, cacti, orchids, and the unusual monocotyledonous genus *Eriocaulon*. Several species are of economic importance: *Hypogeococcus boharti* n. sp., *H. gilli* n. sp., *H. othnius* Miller and McKenzie, and *H. spinosus* Ferris often are encountered at ports-of-entry in the United States and are excluded from the U.S. because they are considered to be potential pests of cacti and orchids. *Hypogeococcus festerianus* (Lizer y Trelles) was introduced into Queensland, Australia as a biological control agent of the weedy cactus *Eriocereus martinii*. McFayden (1979) reported that the mealybug causes deformed and distorted growth to the cactus, and growth and seed development are greatly reduced. McFayden and Tomley (1978) predicted that successful biological control of the cactus in Australia likely would be achieved by the mealybug in combination with an introduced cerambycid.

MATERIALS AND METHODS

Although all specimens in the type series of the new species were examined in detail, a total of 10 specimens was used to determine ranges and means. The 10 specimens were selected from as many localities and hosts as possible. Averages were rounded off to the nearest whole number or to the nearest tenth of a micron. Specific geographic localities are not always given because many collections were taken at U.S. ports-of-entry and specific data are unknown. Specimens were studied using a Zeiss, phase contrast compound microscope at magnifications of 160, 400, and 1000 $\times$.

Terminology is the same as that used by Miller (1975) with the exception of abdominal segmentation of the female. I have followed the numbering system

adopted by Beardsley (1965), with the first visible abdominal segment numbered I. This system, unlike the one used by Ferris (1950), is consistent with the segmentation of the males (Theron, 1958). The term cisanal seta is applied to all of the setae on the venter of segment IX not just the posterior setae as suggested by Ezzat and McConnell (1956) and MacGillivray (1921). This was done to avoid giving each seta on this segment a separate name.

Depositories of types and their abbreviations are as follows: Auburn University, Auburn, Alabama (AUA); British Museum (Natural History), London (BMNH); California Department of Food and Agriculture, Sacramento (CDAS); Florida State Collection of Arthropods, Gainesville (FSCA); Institute of Zoology, Academia Sinica, Beijing, People's Republic of China (IZAS); Museo de Historia Natural de la Ciudad de Mexico, Mexico, D.F. (MCM); Museum National d'Histoire Naturelle, Paris (MNHP); Shanghai Institute of Entomology, Academia Sinica, People's Republic of China (SIE); University of California, Davis (UCD); University of Georgia, Experiment (UG); University of Hawaii at Manoa, Honolulu (UH); United States National Museum of Natural History, Washington, D.C. (USNM); Virginia Polytechnic Institute and State University, Blacksburg (VPI); and Zoological Institute, Academy of Sciences of USSR, Leningrad (ZIL).

Hypogeococcus Rau

Hypogeococcus Rau, 1938:159. Type species: *Hypogeococcus barbarae* Rau, 1938, by monotypy.

Diagnosis of adult females.—Dorsomedial setae on posterior abdominal segments enlarged, often conical, similar to cerarian setae; without trilocular pores; cerarii on abdomen only, with 4–6 pairs; posterior cerarii each with more than 2 conical setae; circulus small and oval, not divided; unusually large anal ring for pseudococcid.

Notes.—No single character can be used to distinguish species of *Hypogeococcus* from all other pseudococcid genera. Members of the genus can be separated by use of a combination of the above mentioned characters; individual species possess a majority but not all of these diagnostic features. In fact, the character states mentioned in the diagnosis are absent on one or more of the included species.

As in previous studies (Ferris, 1953; Miller and McKenzie, 1971), the monophyletic nature of *Hypogeococcus* remains questionable. There appear to be several groups of species within the confines of what currently is considered to be *Hypogeococcus*. These are: 1. *boharti* and *othnius* (without trilocular pores and dorsomedial conical setae, translucent pores absent from hind coxa, anal ring with 2 or 3 rows of pores, first instar with triloculars only and more than 2 cerarii, on orchids); 2. *festerianus*, *pungens*, and *spinosus* (without trilocular pores, dorsomedial conical setae abundant on posterior 4 or 5 abdominal segments, anal ring broad with 2 or 3 rows of pores, translucent pores on hind coxa, first instar with triloculars and 1 or 2 pairs of cerarii, primarily on cactus); 3. *hamoni* and *margaretae* (without trilocular pores, dorsomedial conical setae uncommon on posterior 4 or 5 abdominal segments, anal ring broad, with 6–8 rows of pores, translucent pores on hind coxa, first instar with triloculars and more than 2 pairs of cerarii, on *Eriocaulon*); 4. *barbarae* (with trilocular pores, dorsomedial conical setae abundant on posterior 4 or 5 abdominal segments, anal ring narrow with 2

rows of pores, translucent pores on hind coxa, first instar unknown, on Compositae); 5. *gilli* (with trilocular pores, dorsomedial conical setae abundant on posterior 4 or 5 abdominal segments, anal ring broad with 4 or 5 rows of pores, translucent pores on hind coxa, first instar unknown, on orchids).

Groups 2 and 3 each possess enlarged leg setae, and the basal segment of the labium is closely appressed to the second segment. These characters, which probably are synapomorphies, may suggest a close relationship between these groups.

Douglas J. Williams, Commonwealth Institute of Entomology, London, England and Christina Grana de Willink, Universidad Nacional de Tucuman, Argentina, are continuing their studies of South American species of the genus. According to Doug Williams (pers. corresp.) several problems remain unresolved in regard to the Argentine species. I hesitate to instigate any generic rearrangements until these problems are resolved, until more species are described, and until first instars and adult males have been studied more completely.

Hypogeococcus contains the following species:

1. *barbarae* Rau, 1938:159 (New York) (Compositae).
2. *boharti* Miller, n. sp. (Central America, Mexico) (Orchidaceae).
3. *festerianus* (Lizer y Trelles), 1942:24 (Argentina) (Cactaceae) (see Williams, 1973).
4. *gilli* Miller, n. sp. (Costa Rica) (Orchidaceae).
5. *hamoni* Miller, n. sp., (Florida) (*Eriocaulon*-Eriocaulaceae).
6. *margaretae* Miller, n. sp. (Florida) (*Eriocaulon*-Eriocaulaceae).
7. *othnius* Miller and McKenzie, 1971:578 (Central America, northern South America, Mexico) (Orchidaceae).
8. *pungens* Willink, 1981:61 (Argentina) (*Alternanthera*-Polygonaceae).
9. *spinosus* Ferris, 1953:382 (California, Texas) (Cactaceae).

Pseudococcus mirabilis Brain (1915), an African species, was placed in *Hypogeococcus* by De Lotto (1974). It is clear that *mirabilis* does not belong in the latter genus since it has only slightly enlarged dorsomedial setae, has trilocular pores, has only 2 conical setae in each posterior cerarius, lacks a circulus, and has a narrow, weakly developed anal ring.

KEY TO ADULT FEMALES OF *HYPOGEOCOCCUS* FROM NORTH AND CENTRAL AMERICA

- | | | |
|------|--|---|
| 1. | Trilocular pores present | 2 |
| – | Trilocular pores absent | 3 |
| 2(1) | Oral-collar tubular ducts absent from medial area of dorsum; dorsal area of posterior abdominal segment sclerotized throughout; without a circulus | 2 |
| – | Oral-collar tubular ducts present over dorsal surface; dorsal area of posterior abdominal segment with sclerotization restricted to cerarian area; usually with a circulus | 3 |
| 3(2) | Without conical or enlarged setae on dorsomedial areas of segments VI and VII, these areas with bristle-shaped setae only | 4 |
| – | At least 1 conical or enlarged seta on dorsomedial areas of either or both of segments VI and VII | 5 |
| 4(3) | Posterior 4 pairs of cerarii each with 3 or more conical setae | 5 |
| | <i>boharti</i> Miller, n. sp. | |

- Posterior 4 pairs of cerarii each with 2 conical setae *othnius* Miller and McKenzie
- 5(3) Oral-collar tubular ducts on dorsomedial areas of thorax ... *spinosus* Ferris
- Oral-collar tubular ducts absent from dorsomedial areas of thorax ... 6
- 6(5) Femora of hind 2 pairs of legs with enlarged setae; dorsal setae predominately enlarged; antennae 5-segmented, occasionally with third segment partially divided; penultimate cerarius with same number or more conical setae than anal-lobe cerarius *margaretae* Miller, n. sp.
- Femora of hind 2 pairs of legs without enlarged setae; dorsal setae predominately unenlarged; antennae 6-segmented, or 7-segmented; penultimate cerarius with fewer conical setae than anal-lobe cerarius *hamoni* Miller, n. sp.

Hypogeococcus barbarae Rau

Hypogeococcus barbarae Rau, 1938:159; Ferris, 1953:380; McKenzie, 1967:201; Miller and McKenzie, 1971:578; Williams, 1973:567, De Lotto, 1974:109; Cruttwell and Fidalgo, 1974:1; McFadyen, 1979:284; Willink, 1981:61.

Etymology.—The species epithet was named in honor of Mrs. Barbara Rau, the mother of George Rau.

Type data.—In the original description Rau stated that the holotype was deposited in his private collection. I have been unable to locate Mr. Rau or his collection. None of the type series is part of the holdings of the American Museum of Natural History, Cornell University, or the New York State Museum, Albany. A single slide with data identical to that given by Rau in the original description has been located in the collection of the University of California at Davis. It is labelled in Rau's handwriting as follows: "Hypogeococcus/barbarae Rau/Aster sp./Saratoga Springs,/Sept. 11, 1936./Rau." The slide contains 3 specimens, and although no type designation is on the slide, it clearly is part of the paratype series. Two additional slides each containing 3 specimens are labelled in Ferris' handwriting; they probably are part of the type series, but they lack a specific date in September. Another slide from the type series is deposited in the collection of the British Museum (Natural History). It contains 2 specimens and was collected a year later; it is labelled in Rau's handwriting as follows: "Hypogeococcus/barbarae Rau/On Aster sp./Saratoga Springs,/N.Y. 8/6/37./Paratypes/Rau." Rau apparently tried to recollect the species again in 1938. Specimens collected at Saratoga Springs, on *Aster* sp., in June and late August are also in the collection at Davis, but these specimens are not *Hypogeococcus barbarae* and are not part of the type series. Three topotype specimens on 2 slides deposited in the U.S. National Museum are labelled as *Hypogeococcus barbarae*. These specimens were collected in late September 1936 and 1938 but are not *H. barbarae*; they are similar to species of *Humococcus* by virtue of the form of their anal ring, but their correct identity is uncertain.

ADULT FEMALE (4TH INSTAR) (Fig. 1)

This description is based on the 5 paratype specimens labelled by Rau and the 6 specimens labelled by Ferris mentioned above.

Description.—Mounted 0.9–1.4 (1.2) mm long, 0.6–0.8 (0.7) mm wide. Body elongate oval.

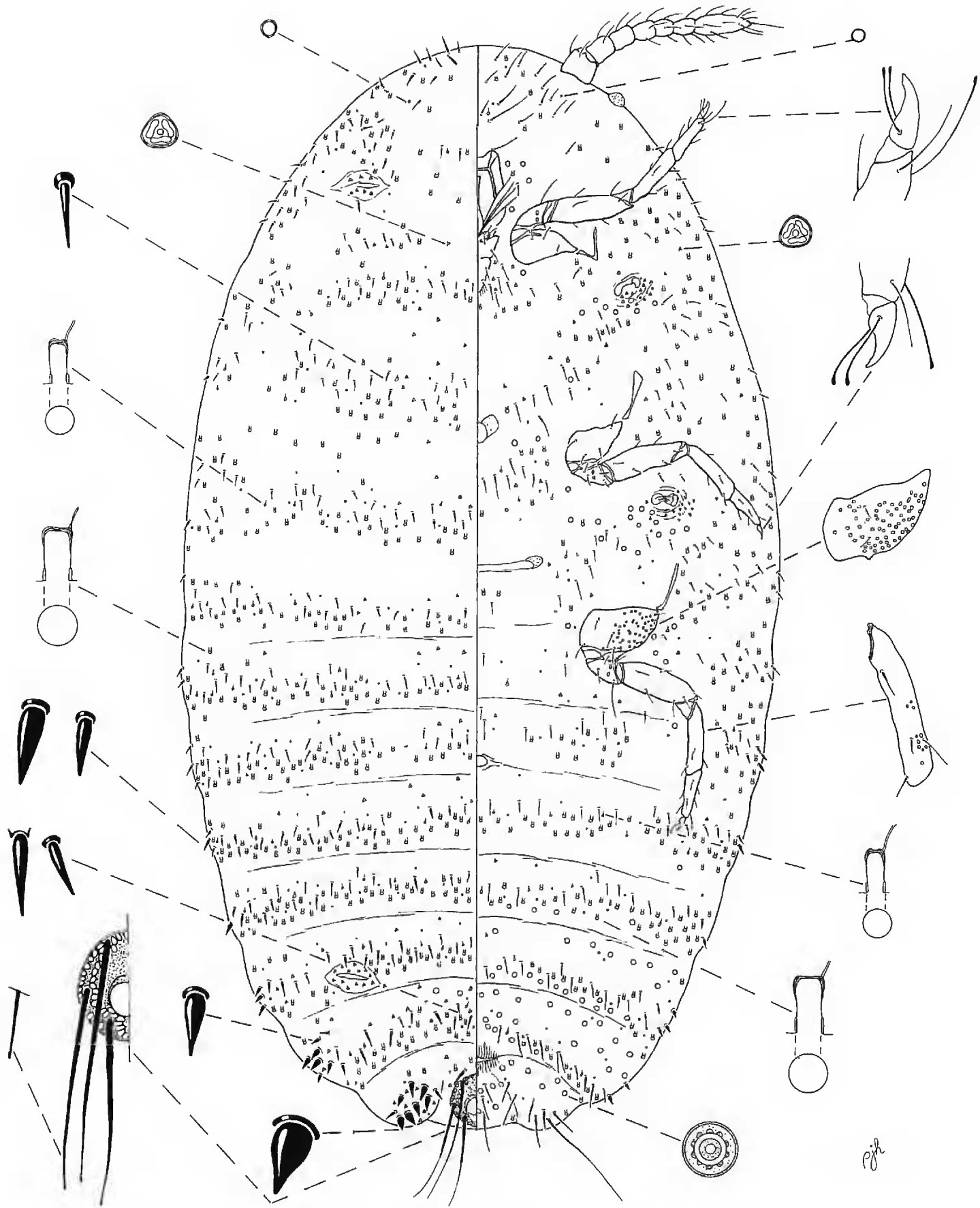


Fig. 1. Adult female paratype of *Hypogeococcus barbarae* Rau. Saratoga Springs, New York, IX-11-36, on *Aster* sp.

Dorsum with 4-6 (6) pairs of cerarii. Anal-lobe cerarius with little or no sclerotization, no bristle-shaped setae, 5-9 (7) conical setae, 5-12 (9) trilocular pores, 0-1 (0) discoidal pores. Penultimate cerarius with 4-9 (7) conical setae, small cluster of trilocular pores. Antepenultimate cerarius with 3-7 (5) conical setae, occasional basal trilocular pore. Fourth cerarius with 1-5 (3) conical setae, without basal trilocular pores. Fifth cerarius with 0-2 (2) conical setae, without associated

trilocular pores. Sixth cerarius with 0-2 (1) conical setae, without associated trilocular pores. With 2 kinds of setae; posterior setae conical, not as large as cerarian setae, gradually becoming thinner anteriorly; setae at juncture of thorax and abdomen thin, not bristle-shaped, present over remainder of abdomen; longest seta on segment VII, excluding those in surrounding cerarian cluster, 20-25 (22) μ long, segment IV with 30-41 (34) setae excluding those in cerarii. Trilocular and discoidal pores scattered over surface, discoidal pores less abundant. Multilocular pores absent from 1 of 11 specimens, when present, with 1-8 (4) pores on 1 or all of segments VI-VIII. Oral-collar tubular ducts of 2 distinct sizes, scattered over surface, without conspicuous collar. Ostioles obvious.

Anal ring on dorsal surface touching apex of abdomen, with 2 rows of pores; anal-ring setae with apex slightly rounded or swollen, longest seta 116-165 (135) μ long, longest seta 1.9-2.4 (2.1) times longer than greatest diameter of anal ring.

Venter with 1 kind of seta; bristle-shaped setae with longest seta on segment VII 27-37 (30) μ long; with 3 pairs of cisanal setae, longest seta 28-47 (37) μ long; longest anal-lobe seta 123-138 (131) μ long; length of longest anal-ring seta/length of longest anal-lobe seta 0.8-1.2 (1.0). Multilocular pores in medial areas near anterior margin of segments VI or VII-IX, in medial areas near posterior margin of segments III, IV, or V-IX, in lateral areas on each abdominal segment rare or absent on III and/or II, multilocular pores present on thorax in clusters surrounding mouthparts, spiracles, and legs. Trilocular and discoidal pores scattered over surface. Oral-collar tubular ducts of same 2 sizes as on dorsum, present over surface. Ventral anal lobe weakly sclerotized.

Circulus absent from 4 of 11 specimens, when present, transversely oval, width/length 1.0-1.7 (1.3), 12-37 (28) μ wide. Hind legs with 42-112 (79) translucent pores on dorsal surface of hind coxa, 49-86 (66) on ventral surface; with 3 translucent pores on 1 femur of 1 specimen, absent from femora of remaining specimens; hind tibiae with translucent pores on 9 of 10 specimens, when present, with 4-17 (8) pores arranged in 2 clusters on dorsal surface. Hind femora 101-114 (108) μ long; tibiae 73-91 (84) μ long; tarsi 52-62 (57) μ long; length of femur/tibia 1.2-1.5 (1.3); length of tibia/tarsus 1.4-1.6 (1.5). Tibiae with 5-7 (6) setae, those on lateral surface (as drawn) very small. Leg setae bristle shaped; digitules usually broken, tarsal digitules apparently reaching tip of claw, digitules of all 3 pairs of legs each apparently with 1 thick seta with capitate apex and 1 thin seta with acute apex; claw digitules extending beyond apex of claw, with conspicuous club, about equal in size. Antennae 7-segmented, 168-217 (200) μ long, with bristle-shaped setae. Labium with basal segment separate, 67-81 (74) μ long. Eye without associated discoidal pores.

Comparison.—Adult females of *Hypogeococcus barbarae* and *H. gilli* superficially are similar by having trilocular pores. In addition to the characters used in the key, *H. barbarae* differs by having the anal-lobe cerarius with 5-9 (7) conical setae, 5-12 (9) trilocular pores, and 0-1 (0) discoidal pores, by having dorsal multilocular pores absent or present in the dorsomedial areas of the posterior abdominal segments, 2 distinct sizes of oral-collar tubular ducts, longest anal-ring seta 116-165 (135) μ long, 3 pairs of cisanal setae, longest anal-lobe seta 123-138 (131) μ long, multilocular pores present around mouthparts, hind coxae with 42-112 (79) translucent pores on the dorsal surface, hind tarsi each 52-62 (57) μ long, hind tibiae each with 5-7 (6) setae, antennae each 168-217 (200) μ long.

Hypogeococcus gilli has the anal-lobe cerarii each with 9–14 (12) conical setae, 17–21 (19) trilocular pores, and 1–3 (2) discoidal pores, has the dorsal multilocular pores absent from the medial areas, 1 size of oral-collar tubular duct, longest anal-ring seta 205–217 (213) μ long, 2 pairs of cisanal setae, longest anal-lobe seta 163–187 (177) μ long, multilocular pores absent from area around mouthparts, hind coxae each with 15–21 (18) translucent pores on the dorsal surface, hind tarsi each 87–103 (97) μ long, hind tibiae each with 9–10 (9) setae, antennae each 246–273 (256) μ long.

***Hypogeococcus boharti* Miller, NEW SPECIES**

Etymology.—The species epithet is given in recognition of the many scientific accomplishments of Dr. Richard M. Bohart and of the many hours that he spent teaching me about insect systematics. Dick's never ending enthusiasm and energy for acquiring new knowledge about the taxonomy of insects has been an important inspiration to my career as a systematist.

Although most know him as an authority of the Hymenoptera, he also has contributed to the field of coccidology. In 1942 he published a paper on the life history of the armored-scale pest *Diaspis boisduvalii* Signoret, and it remains the most important work on the biology of the species. In 1958 he collected an undescribed species of mealybug that later was named in his honor (*Rhizoecus boharti* McKenzie) by McKenzie (1960). It was through Dick Bohart's administrative efforts that Howard L. McKenzie was hired at the University of California at Davis and the Gordon F. Ferris collection of scale insects was obtained and incorporated in the Entomology Department's Collection. Dick's encouragement and advice had major impact on the highly productive, later years of Howard McKenzie's research career. Therefore, this species is named in honor of Dick Bohart for his several contributions to the field of scale-insect systematics. It seems especially appropriate that the epithet "boharti" be given to this orchid infesting species since his 1942 paper was about a pest of *Cattleya* orchids.

Type data.—Holotype adult ♀, right specimens of 3 on slide, with left label "Hypogeococcus/DRAW/On Orchidaceae/leaf Mexico/(Coyutla Vera Cruz)/at Hidalgo 1359 I-1-1974 75-6363/D. R. Riley colr."; right label has a map showing position of holotype and "Hypogeococcus/boharti/Miller/HOLOTYPE" (USNM). In addition to the holotype there are 44 paratype specimens on 22 slides. The paratype data are as follows: BELIZE—On orchid, III-6-70, J. C. Buff. CANAL ZONE—On orchid, IV-7-75, H. L. Rubin. EL SALVADOR—On *Oncidium ornithorhynchum*, II-25-69, B. E. Davis, A. J. Benton. GUATEMALA—On *Oncidium cristagolli*, VI-10-65, R. Reasoner; on orchid, V-30-80, F. Matthews. HONDURAS—On orchid, III-7-77, W. Forster; on orchid, I-5-81, J. Torres; on orchid, VIII-26-81, F. Matthews; on *Oncidium* sp., II-18-75, F. Matthews; on Orchidaceae, VII-31-68, L. R. Gillogly. MEXICO—On *Odontoglossum bicto-niense*, VI-18-73, G. L. Piro; on orchid, V-21-51, Cary; on *Sobralia* sp., III-29-38, R. H. Buffham; Coyutla, on Orchidaceae, I-1-74, D. R. Riley; Oaxaca, on orchids, XII-6-65, L. R. Gillogly; Vera Cruz, on *Coffea arabica*, II-1-67, G. K. Browne; Vera Cruz, on orchid, I-1-74, D. R. Riley. Paratype slides have been deposited in BMNH, CDAS, FSCA, MCM, MNHP, UCD, UG, UH, USNM, VPI, and ZIL.

ADULT FEMALE (4TH INSTAR)
(Fig. 2)

Description.—Holotype mounted, 1.5 mm long (paratypes 1.6–2.7 (2.0) mm), 0.7 mm wide (paratypes 0.8–1.6 (1.1) mm). Body elongate oval.

Dorsum with 5 and 6 pairs of cerarii (paratypes with 5–7 (6) cerarii). Anal-lobe cerarius, including ventral area with conical setae, with basal sclerotization, 7 bristle-shaped setae, 9 and 8 conical setae, 6 multilocular pores, 3 discoidal pores (paratypes with 5–7 (6) bristle-shaped setae, 3–9 (7) conical setae, 1–6 (4) multilocular pores, 1–5 (3) discoidal pores). Penultimate cerarius with basal sclerotization, 11 conical setae (paratypes with 7–14 (10) conical setae) and several bristle-shaped setae, oral-collar tubular ducts, multilocular and discoidal pores. Antepenultimate cerarius with slight basal sclerotization, 7 and 8 conical setae (paratypes with 5–11 (8) conical setae), and 1 or more bristle-shaped setae, oral-collar tubular ducts, multilocular and discoidal pores. Fourth cerarius with or without weak basal sclerotization, 6 and 7 conical setae (paratypes with 3–7 (6) conical setae), and 1 or more oral-collar tubular ducts and discoidal pores. Fifth cerarius with 4 and 5 conical setae (paratypes with 3–7 (4) conical setae), and 1 or more oral-collar tubular ducts and discoidal pores. Sixth cerarius absent on 1 side with 2 conical setae on other (paratypes with 0–3 (2) conical setae) and 1 or more discoidal pores. Seventh cerarius absent (present on 6 of 10 paratypes, with 0–3 (1) conical setae). With 1 kind of seta; bristle-shaped setae longer posteriorly; longest seta on segment VII, excluding those surrounding cerarian cluster, 55 μ long (paratypes 47–75 (57) μ); segment IV with 33 setae, excluding those in cerarii (paratypes with 27–35 (31) setae). Trilocular pores absent. Discoidal pores scattered over surface; small, irregular sclerotized spots also scattered over surface. Multilocular pores present over surface, least abundant near posterior apex. Oral-collar tubular ducts with inconspicuous collar, short, in marginal or submarginal areas of head to segment VII, in mediolateral areas of all segments except prothorax, mesothorax, and segment VIII (paratypes with oral collars absent from mediolateral areas of segment VIII and any or all of prothorax, mesothorax, metathorax, or segment I), in medial areas on all segments except segment VIII and prothorax to segment 2 (paratypes with medial oral collars absent from prothorax to segment I, II, III, or IV, and absent from segment VIII). Ostioles small.

Anal ring dorsal, touching apex of abdomen (3 of 10 paratypes with anal ring bent around posterior apex of abdomen), with 2 or 3 rows of pores; anal-ring setae with narrow, acute apices, largest seta 240 μ long (paratypes 215–245 (228) μ), longest seta 2.7 times longer than greatest diameter of ring (paratypes 2.3–3.1 (2.6) times).

Venter with bristle-shaped setae only, excluding setae in cerarii; with 3 pairs of cisanal setae, longest cisanal seta 40 μ long (paratypes 27–43 (38) μ); anal-lobe setae 157 and 153 μ long (paratypes 110–173 (138) μ); length of longest anal-ring seta/length of longest anal-lobe seta 1.5 (paratypes 1.3–2.0 (1.7) units). Multilocular pores scattered over surface except anterior margin of medial areas of segments I–VI (paratypes with multiloculars absent from anterior margin of segments I, II, or III to V or VI), posterior margin of medial areas of segments I–IV (paratypes

areas of segments IV-VI (paratypes with oral collars from II, III, or IV to VI or VII). Ventral anal-lobe area broadly sclerotized, with 1 or 2 conical setae, bristle-shaped setae, multilocular and discoidal pores.

Circulus nearly round, width/length 1.1 (paratypes 0.9-1.3 (1.0) units), 35 μ wide (paratypes 30-60 (40) μ). Hind legs with 35 and 29 translucent pores on dorsal surface of each femur arranged in cluster near distal apex of anterior margin (as drawn) and in cluster along posterior margin (paratypes with 13-35 (26) pores, occasionally without distal cluster); tibia with 27 and 48 pores on dorsal surface scattered along outer margin (as drawn) (paratypes with 26-42 (33) pores). Hind femora 155 and 153 μ long (paratypes 140-165 (151) μ); tibiae 107 and 113 μ long (paratypes 104-123 (112) μ); tarsi each 67 μ long (paratypes 61-73 (67) μ); length of femur/tibia 1.4 (paratypes 1.3-1.4 (1.3) units); length of tibia/tarsus 1.6 and 1.7 (paratypes 1.5-1.7 (1.7) units). Tibiae with 8 and 9 setae (paratypes with 9-10 (9) setae). Leg setae bristle shaped; tarsal digitules not quite reaching tip of claw, digitules of hind 2 pairs of legs approximately equal in length, 1 noticeably more slender than other including apical club, digitules of front legs unequal, 1 without apical club, other similar to digitules of hind tarsi; claw digitules extending beyond apex of claw, equal in size, slightly larger than largest tarsal digitule. Antennae 6- and 7-segmented (paratypes 6- and 7-(7-)segmented), 6-segmented antenna with third segment partially divided, 263 and 250 μ long (paratypes 245-310 (275) μ), with bristle-shaped setae. Labium with basal segment separate, 90 μ long (paratypes 93-113 (99) μ). Eye with 2 and 3 loosely associated discoidal pores (paratypes with 1-3 (2) pores).

THIRD-INSTAR FEMALE

(Fig. 3)

Description.—Mounted, 1.1 and 1.2 mm long, 0.5 and 0.6 mm wide. Body elongate.

Dorsum with 5-6 (5) pairs of cerarii. Anal-lobe cerarius, including ventral area with conical setae, with basal sclerotization, 2-3 (3) bristle-shaped setae, 4-5 (4) conical setae, 1-2 (1) multilocular pores, 0-1 (0) discoidal pores. Penultimate cerarius with basal sclerotization, 5-7 (6) conical setae, and 1 or more bristle-shaped setae, discoidal pore, and oral-collar tubular duct. Antepenultimate cerarius with slight basal sclerotization, 3-5 (4) conical setae. Fourth cerarius with or without weak basal sclerotization, 3-4 (3) conical setae. Fifth cerarius with 3-4 (3) conical setae. Sixth cerarius with 0-2 (1) conical seta. With 1 kind of seta; bristle-shaped setae longer posteriorly; longest seta on segment VII, excluding those surrounding cerarian cluster, 40 and 43 μ long; segment IV with 18 setae, excluding those in cerarii. Trilocular pores absent. Discoidal pores scattered over surface; small, irregular sclerotized spots also scattered over surface. Multilocular pores present over surface, least abundant medially. Oral-collar tubular ducts of same structure as on adult, in marginal and submarginal areas of head to segment VII, in mediolateral areas of all segments except prothorax to segment I and segment VIII, in medial areas of all except prothorax to segment III and segment VIII on 1 specimen, absent from medial area on other specimen. Ostioles small.

Anal ring bent around posterior apex of abdomen, with 2 rows of pores; anal-ring setae with acute apices, longest seta 145 and 170 μ long, longest seta 1.9 and 2.9 times longer than greatest diameter of ring.

same size and shape as on dorsum, on marginal and submarginal areas of head to segment VII in mediolateral areas of segment V on 1 specimen, V and VI on other, absent medially. Ventral anal-lobe area broadly sclerotized, with bristle-shaped setae, multilocular and discoidal pores.

Circulus nearly round width/length 1.1 and 1.3, 20 and 25 μ wide. Hind legs with traces of translucent pores on femora and tibiae (these pores may be from the legs of the adult before shedding). Hind femora 105–117 (110) μ long; tibiae 73–80 (76) μ long; tarsi 67–80 (68) μ long; length of femur/tibia 1.4–1.5 (1.4); length of tibia/tarsus 1.1. Tibiae with 9 setae. Leg setae bristle-shaped; digitules same as on adult. Antennae 6-segmented, 1 antenna with third segment partially divided, 203–230 (219) μ long, with bristle-shaped setae. Labium with basal segment separate, 75 and 73 μ long. Eye with 0–2 (1) loosely associated discoidal pores.

FIRST INSTAR

Specimens examined.—The following description is based on 42 embryos from the following 6 localities (complete data given under “Type Data”): Belize; Guatemala (1965 and 1980); Honduras (I-5-1981); Mexico (1938 and 1974).

Description.—Only salient features are included because of the poor condition of the available material.

Mounted 326–440 (391) μ long, 175–225 (198) μ wide. Body elongate.

Dorsum with 4–5 (4) pairs of cerarii that have at least 1 conical seta, with up to 14 paired, enlarged bristle-shaped setae along each body margin including those with conical setae; cerarii usually without associated pores, without basal sclerotization. Anal-lobe cerarii with 2 conical setae, 1 trilocular pore between cerarian setae; penultimate and antepenultimate cerarii each with 2 conical setae; fourth cerarii with 1–2 (1) conical setae, 0–1 (0) bristle-shaped setae; fifth cerarii with 0–1 (0) conical setae, 1–2 (2) bristle-shaped setae. With 1 kind of seta; bristle-shaped setae scattered over dorsum, arranged in 4 longitudinal lines on most of abdomen, shortest setae in center of body; longest seta on segment VII 17–27 (23) μ long, segment IV with 4 setae excluding those in cerarii. Trilocular pores scattered over surface, on abdomen usually with 1 pore between each cerarius and mediolateral seta, and 1 pore between each mediolateral seta and medial seta, located between anterior and posterior margin of each segment, forming 4 longitudinal lines of trilocular pores on abdomen. Discoidal and multilocular pores absent. Tubular ducts absent. Ostioles present.

Anal ring apical, with 2 rows of pores; anal-ring setae with acute apices, longest setae 54–73 (63) μ long.

Venter with 1 kind of seta, forming 6 longitudinal lines of setae on abdomen; bristle-shaped setae scattered over surface, longest seta 16–37 (25) μ long; longest anal-lobe seta 50–55 (52) μ long. Trilocular pores associated with submarginal and mediolateral lines of setae on abdomen. Multilocular pores absent. Discoidal pores associated with submarginal line of setae. Tubular ducts absent. Ventral anal-lobe area not sclerotized.

Circulus oval, not divided, 8–11 (10) μ wide. Legs unclear; tibia with 7–8 (7) setae; leg setae bristle shaped; tarsal digitules extending beyond tip of claw, digitules of hind 2 pairs of legs equal in length, 1 noticeably more slender than other, digitules of front legs unequal, 1 without apical club, other about same as larger

digitule on hind legs; claw digitules extending beyond tip of claw, 1 digitule slightly thinner than other. Antennae unclear. Labium details unclear. Eye with 1 associated discoidal pore.

Comparison.—Adult females of *H. boharti* and *H. othnius* are similar; both lack dorsomedial conical setae, have 2 or 3 rows of pores in the anal ring, have apices of the anal-ring setae slightly rounded or capitate, have the length of the longest anal-ring seta/the greatest diameter of the anal ring about 2.6, have the longest anal-ring seta about 220 μ long, have translucent pores on the femur and tibia, usually have a discoidal pore associated with the eye, and occur on orchids. *Hypogeococcus boharti* differs by having more than 2 conical setae in each of the posterior 4 pairs of cerarii, and circulus oval, rarely longer than wide; *H. othnius* has 2 conical setae in each of posterior 4 pairs of cerarii (1 specimen has 1 cerarius with 3 conical setae), and circulus elongate, usually longer than wide. The above mentioned species share several similarities with *H. gilli*; all have the apex of the anal-ring setae rounded or capitate, usually have 7-segmented antennae, and have 9 or 10 setae on each hind tibia. *Hypogeococcus gilli* is easily separated by having trilocular pores, by lacking a circulus, by having many pores near the base of the cerarian conical setae in the anal-lobe cerarius, and by having translucent pores on the hind coxa; *H. boharti* and *H. othnius* lack trilocular pores, have a circulus, lack pores near the base of the cerarian conical setae in the anal-lobe cerarius, lack translucent pores on the hind coxa.

A comparison of *H. boharti* and *H. margaretae* is given in the species treatment of the latter species.

Hypogeococcus gilli Miller, NEW SPECIES

Etymology.—The species epithet is named in honor of Mr. Raymond J. Gill, California Department of Food and Agriculture, Sacramento, not only for providing the type series of this species, but also for his dedication and many important contributions to the study of scale-insect systematics.

Type data.—Holotype adult ♀, single specimen on slide, with left label “Hypogeococcus/gilli Miller/HOLOTYPE/Det. by CDA/VII-62/C₄N₈O AF + LP-B.”; right label “sp. 13033/No. 62G20-55 Cal. Dept. Agr./Q. fr./Loc. Costa Rica at San/Pedro, California/17-VII-1962/ex. orchid leaf/Draw/J. Lindsay coll” (USNM). In addition, there are 2 adult female paratypes on 2 slides with the same data (CDAS and BMNH).

ADULT FEMALE (4TH INSTAR)

(Fig. 4)

Description.—Holotype, mounted, 1.7 mm long (paratypes 1.8 and 2.0 (1.9) mm) 0.8 mm wide (paratypes each 1.0 mm). Body elongate oval.

Dorsum with 5 pairs of cerarii, sixth pair reduced to single conical seta on 1 side of specimen, with 2 such setae on other side (1 paratype with definite sixth cerarius with basal sclerotization). Anal-lobe cerarius part of sclerotized plate on dorsum of segment VIII, with 11 conical setae, 17 trilocular pores, 2 discoidal pores (paratypes with 9–14 (12) conical setae, 17–21 (19) trilocular pores, and 1–3 (2) discoidal pores). Penultimate cerarius defined by basal sclerotization extending on to ventral surface with 11 and 12 conical setae with 2 larger than others (paratypes with 11–18 (14) conical setae), with cluster of basal trilocular

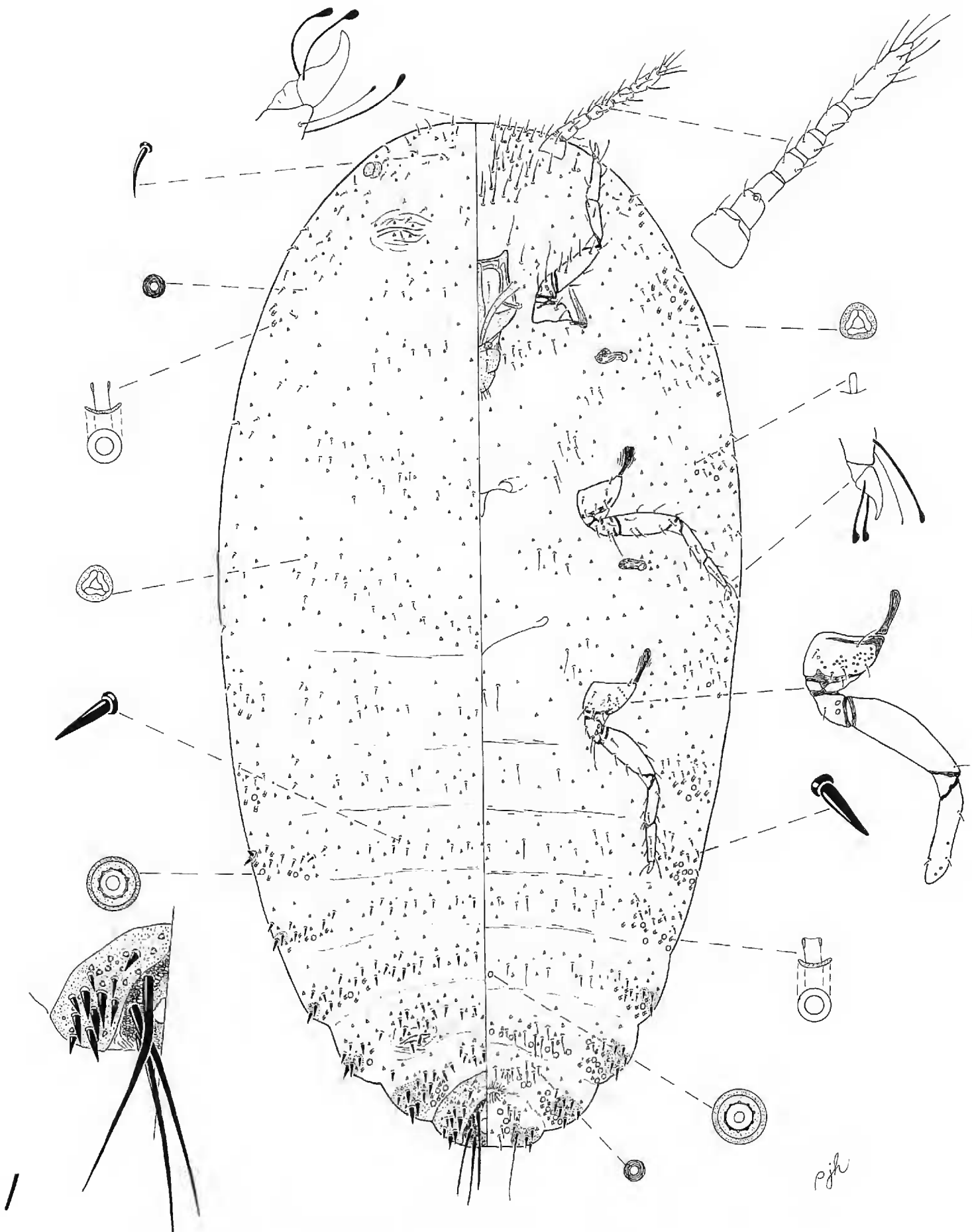


Fig. 4. Adult female holotype of *Hypogeococcus gilli* n. sp. Costa Rica (quarantined at San Pedro, California), VII-17-62, on "orchid leaf."

pores and discoidal pores. Antepenultimate cerarius with 8 and 11 conical setae with 2 larger than others (paratypes with 5-9 (7) conical setae), basal sclerotization, cluster of trilocular pores. Fourth cerarius with 3 and 5 conical setae with 2 larger than others (paratypes with 2-5 (3) conical setae), basal sclerotization, few trilocular pores. Fifth cerarius with 2 conical setae (paratypes with 2-3 (2) such setae),

basal sclerotization, 1 or 2 trilocular pores. With 2 kinds of setae; conical setae in medial and mediolateral areas of segments IV–VII, in mediolateral areas only of segments III and VIII; remainder of dorsum with bristle-shaped setae; longest seta on segment VII, excluding those surrounding cerarian cluster, 25 μ long (paratypes 25 and 27 μ), segment IV with 29 setae excluding those in cerarii (paratypes with 35 and 37). Trilocular and discoidal pores scattered over surface, discoidals less abundant. Multilocular pores in marginal and submarginal areas of segment II–VII on 1 side, II, IV–VII on other side (paratypes with these pores from metathorax, segments I, II, or III–VII). Oral-collar tubular ducts inconspicuous, with unusually short duct and darkly staining collar in marginal or submarginal areas of prothorax, segments I–VII on 1 side, II–VII on other side (paratypes without dorsal oral-collar tubular ducts on thorax). Ostioles obvious.

Anal ring on dorsal surface touching apex of abdomen, with 4 or 5 rows of pores; anal-ring setae broken at apex except 1, apex of unbroken seta rounded (paratypes with apices of anal-ring setae rounded), longest 217 μ long (paratypes 205 and 216 μ), longest seta 2.2 times longer than greatest diameter of anal ring (paratypes each 2.2 times).

Venter with 2 kinds of setae; conical setae restricted to marginal and submarginal areas of abdominal segments; bristle-shaped setae with longest seta on segment VII 45 μ long (paratypes 30 μ long); with 2 pairs of cisanal setae, longest seta 50 μ long (broken on paratypes); longest anal-lobe seta 187 μ long (paratypes 163 and 180 μ long); length of longest anal-ring seta/length of longest anal-lobe seta 1.2 (paratypes 1.2 and 1.3). Multilocular pores in medial and mediolateral areas of segments V–VIII (paratypes VI–VIII), in marginal and submarginal areas of segments II–IV, on thorax anterior of each spiracle, represented by 1, 2, or 3 pores in each cluster (paratypes with thoracic clusters each represented by 1–5 (3) pores). Trilocular and discoidal pores scattered over surface, least abundant near center of surface. Oral-collar tubular ducts of same size and shape as on dorsum generally in same areas as multiloculars. Ventral anal-lobe area broadly sclerotized.

Circulus absent. Hind legs with 22 translucent pores on dorsal surface of each coxa (paratypes 15–21 (18) pores), 23 and 25 pores on ventral surface of each coxa (paratypes 11–29 (21) pores); tibia with 3 and 6 pores on dorsal surface (paratypes 2–9 (5) pores), absent from ventral surface. Hind femora 125 and 127 μ long (paratypes 113–135 (127) μ); tibiae 87 and 93 μ long (paratypes 93–103 (97) μ); tarsi 73 and 75 μ long (paratypes 70–75 (73) μ); length of femur/tibia 1.4 (paratypes 1.2–1.7 (1.4) units); length of tibia/tarsus 1.2 (paratypes 1.2–1.4 (1.3) units). Leg setae bristle shaped except 2 setae at distal apex of inner side of tibia; tibia with 9 and 10 setae (paratypes 9–10 (9) setae); tarsal digitules extending beyond apex of claw, apical clubs of unequal size; claw digitules extending beyond apex of claw, equal in size, about equal in size to largest tarsal digitule. Antennae 7-segmented, 260 μ long (paratypes 246–273 (256) μ). Labium with basal segment separate, 75 μ long (paratypes 87 and 100 μ). Eye without associated pores.

Comparison.—*Hypogeococcus gilli* is similar to *H. barbarae* by having trilocular pores. For a comparison of these species see the description of the latter. A comparison of *H. gilli* is also made in the description of *H. boharti*.

Hypogeococcus hamoni Miller, NEW SPECIES

Etymology.—The species epithet is named in honor of Dr. Avas B. Hamon,

Florida Department of Agriculture and Consumer Services, Gainesville, for providing specimens of many interesting mealybugs from Florida including this species.

Type data.—Holotype adult ♀, single specimen on slide, with left label “Hypogeococcus/hamoni/Miller/HOLOTYPE”; right label “Palatka, Fla./17 VI 1980/on/Eriocaulon/compressum/DPI#126354/draw imm. USNM/Balsam” (USNM). In addition, there are 2 adult female paratypes on 2 slides with the same data (FSCA and BMNH).

ADULT FEMALE (4TH INSTAR)
(Fig. 5)

Description.—Holotype, mounted 1.6 mm long (paratypes 1.6 and 1.8 mm), 0.9 mm wide (paratypes 0.8 and 1.0 mm). Body elongate.

Dorsum with 4 and 5 pairs of cerarii (paratypes with 5). Anal-lobe cerarius, including ventral area with conical setae, with basal sclerotization, 0 and 1 bristle-shaped setae, 10 and 11 conical setae, no pores (paratypes with 10–11 (10) conical setae, 0–2 (1) bristle-shaped setae, no multilocular or discoidal pores). Penultimate cerarius with weak basal sclerotization, 5 conical setae, without pores (paratypes with 3–4 (4) conical setae). Antepenultimate cerarius without basal sclerotization, 2 and 3 conical setae, no associated pores (paratypes with 2 conical setae). Fourth cerarius without basal sclerotization, 2 conical setae, no pores (paratypes also with 2 conical setae). Fifth cerarius absent from 1 side, with 1 conical seta on other, without pores (paratypes with 1–2 (1) conical setae). With 2 kinds of setae; basally enlarged bristle-shaped setae restricted to medial areas of segments VI and VII; bristle-shaped setae scattered elsewhere, all about same size except larger near anterior and posterior apices of body; longest seta on segment VII, excluding those surrounding cerarian cluster, 40 μ long (paratypes 40 and 45 μ), segment IV with 18 setae, excluding those in cerarii (paratypes with 16 and 19 setae). Trilocular pores absent. Discoidal pores scattered over surface. Multilocular pores present over surface, least abundant in center of body and near posterior apex. Oral-collar tubular ducts with inconspicuous collar, short, in marginal or submarginal areas of head to segment VII, in medial and mediolateral areas of segments III–VII (paratypes with medial or mediolateral oral collars on segments IV and V on 1 specimen, on III–VII on other). Ostioles small and inconspicuous.

Anal ring dorsal, touching apex of abdomen, with 7–9 rows of pores; anal-ring setae with acute apices, longest seta 143 μ long (paratypes 143 and 140 μ), longest seta 1.4 times longer than greatest diameter of ring (paratypes 1.5 and 1.4 times).

Venter with bristle-shaped setae only, excluding setae in cerarii; longest seta on segment VII 25 μ long (paratypes 37 μ); with 2 pairs of cisanal setae, longest cisanal seta 40 μ long (paratypes 40 and 30 μ); anal-lobe setae broken on all specimens. Multilocular pores scattered over surface, most abundant near posterior margin of segments V–VII, sparse in medial areas of segments I–III. Trilocular pores absent. Discoidal pores in small numbers over surface. Oral-collar tubular ducts of same size and shape as on dorsum; in marginal or submarginal areas of prothorax to segment VIII, in medial or mediolateral areas of segments V–VII (paratypes with marginal and submarginal oral collars from head or prothorax to segment VII, medial oral collars absent from 1 specimen, on segments VI and VII on other). Ventral anal-lobe area broadly sclerotized, with several bristle-shaped setae.

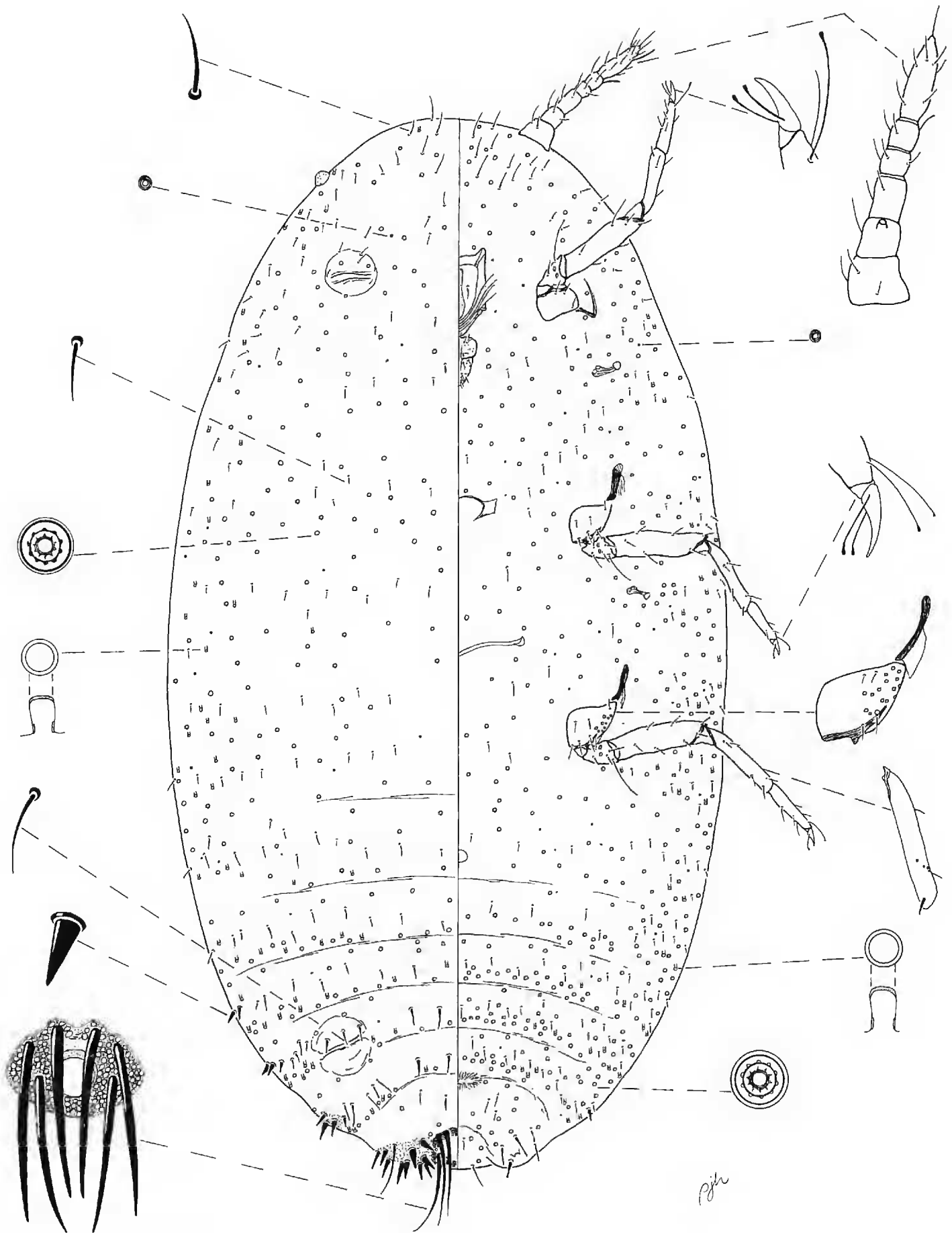


Fig. 5. Adult female holotype of *Hypogeococcus hamoni* n. sp. Palatka, Florida, VI-17-80, on *Eriocaulon compressa*.

Circulus oval, width/length 1.3 (paratypes 1.4 units) not divided, 29 μ wide (paratypes 31 and 33 μ). Hind legs with 14 and 17 translucent pores on dorsal surface of each coxa (paratypes 11–19 (15) pores), 9 and 11 pores on ventral surface of each coxa (paratypes 10–21 (17) pores); tibia without pores 1 side with 7 pores on other (paratypes 0–4 (2) pores). Hind femora 177 and 180 μ long

(paratypes 187–195 (191) μ); tibiae 150 and 160 μ long (paratypes 157–167 (164) μ); tarsi 83 and 95 μ long (paratypes 93–103 (99) μ); length of femur/tibia 1.1 and 1.2 (paratypes 1.1–1.2 (1.2) units); length of tibia/tarsus 1.7 and 1.8 (paratypes 1.6–1.8 (1.7) units). Tibia with 7 setae (paratypes with 5–7 (6) setae). Leg setae bristle shaped; tarsal digitules not quite reaching tip of claw, digitules of hind 2 pairs of legs unequal in length, with apical clubs of approximately same size, digitules of front legs unequal, 1 without apical club, other similar to digitule of hind tarsi; claw digitules extending beyond apex of claw, equal in size, about equal to largest tarsal digitule. Antennae 6-segmented (paratypes 6-segmented and 7-segmented), with third segments partially divided, 217 μ long (paratypes 210–230 (222) μ), with bristle-shaped setae. Labium with basal segment fused with second segment, 85 μ long (paratypes 85 and 87 μ). Eyes without associated pores.

Comparison.—Adult females of *Hypogeococcus hamoni* and *H. margaretae* are similar; both lack multilocular pores associated with anal-lobe cerarius, have the anal ring with 7–9 rows of pores, have translucent pores on the hind coxa and tibia, have the hind femora longer than 177 μ and the hind tibia longer than 140 μ , and have the basal labial segment closely appressed to the second segment. *Hypogeococcus hamoni* differs by having 10–11 (10) conical setae in each anal-lobe cerarius, having few or no enlarged bristle-shaped setae on the dorsum, having 16–19 (18) dorsal setae on segment IV excluding those in the cerarii, having short setae (longest seta on dorsum of segment VII 40–45 μ long, longest seta on venter of segment VII 25–37 μ long, longest cisanal seta 30–40 μ long), having 5–7 (6) setae on each hind tibia, and having 6- or 7-(6-)segmented antennae; *H. margaretae* has 24–40 (26) conical setae in each anal-lobe cerarius, has numerous, conspicuous enlarged bristle-shaped setae over the dorsum, has 33–48 (42) dorsal setae on segment IV excluding those in cerarii, has long setae (longest seta on dorsum of segment VII 57–80 (68) μ long, longest seta on venter of segment VII 35–50 (42) μ long, longest cisanal seta 60–123 (85) μ long), has 8–9 (9) setae on each hind tibia, and has 5- or 6-(5-)segmented antennae. The above mentioned species share with *H. spinosus* the occurrence of enlarged leg setae, short anal-ring setae, and the basal labial segment which is closely appressed with the second segment. *Hypogeococcus spinosus* is readily separated by having dorsomedial conical setae on abdominal segments II and III, having 2 or 3 rows of pores in the anal ring, having 4 pairs of cisanal setae, having 7-segmented antennae, and having hind length of tibia/tarsus about 1.3; *H. hamoni* and *H. margaretae* differ by having dorsomedial conical setae absent from abdominal segments II and III, having 7–9 rows of pores in the anal ring, having 3 pairs of cisanal setae, usually having less than 7-segmented antennae, and having hind length of tibia/tarsus about 1.7 or 1.8.

Hypogeococcus margaretae Miller, NEW SPECIES

Etymology.—The species epithet is formed in honor of Mrs. Margaret E. Russell Bohart, who has been a major contributor to the scientific achievements of the Bohart regime at Davis. It is clear that many of the research and administrative achievements of Dick Bohart could not have been accomplished without Margaret's devotion to science and support of many, necessary behind-the-scenes activities. Therefore, it is appropriate that Margaret Bohart be honored along with her husband.

Type data.—Holotype adult ♀, single specimen on slide, with left label “Hypogeococcus/margaretae/Miller/HOLOTYPE”; right label “nr. Port St. Lucie, 0.3 mi N. Hiway 609/on Hiway 709, St./Lucie Co., Fla./17-XII-1981/K. Hibbard/on Eriocaulon/decanulare/DPI-126357” (USNM). In addition there are 11 paratypes on 11 slides from the same locality collected on the same date, 25 paratypes on 25 slides from the same locality collected 28-VII-1982, and 4 paratypes on 2 slides from Jackson Co., Mississippi, V-2-76, B. J. Muse, on *Eriocaulon* sp. Paratype slides have been deposited in AUA, BMNH, CDAS, FSCA, IZAS, MCM, MNHP, SIE, UCD, UG, UH, USNM, VPI, and ZIL.

ADULT FEMALE (4TH INSTAR)

(Fig. 6)

Description.—Holotype, mounted, 1.8 mm long (paratypes 1.4–2.6 (2.1) mm), 0.9 mm wide (paratype 0.8–1.3 (1.0) mm). Body elongate.

Dorsum with 4 and 6 pairs of cerarii (paratypes with 4–6 (5) cerarii). Anal-lobe cerarius including ventral area with conical setae, with basal sclerotization, 25 and 26 conical setae, no pores (paratypes with 24–30 (26) conical setae, 0–3 (0) enlarged, bristle-shaped setae, no multilocular pores, 0–1 (0) sclerotized discoidal pores). Penultimate cerarius defined by basal sclerotization extending onto ventral surface with 13 and 15 conical setae, without pores (paratypes with 12–16 (14) conical setae). Antepenultimate cerarius with basal sclerotization, 5 and 8 conical setae, no associated pores (paratypes with 4–8 (6) conical setae). Fourth cerarius with basal sclerotization, 3 and 4 conical setae, no pores (paratypes with 3–6 (4) conical setae). Fifth cerarius without basal sclerotization, with 1 and 2 conical setae, without associated pores (paratypes with or without basal sclerotization, with 1–5 (2) conical setae). Sixth cerarius absent from 1 side, on other side without basal sclerotization and associated pores, with 2 conical setae (paratypes with sixth cerarius on 6 of 10 specimens, when present, without basal sclerotization and associated pores, with 1–2 (1) conical setae). With 2 kinds of setae; conical setae on medial areas of segments VI and VII (on paratypes on any or all of segments IV–VII), on mediolateral areas of segments V–VII (on paratypes on any or all of segments III–VII), on submarginal areas of segment VII (paratypes usually with these setae on 1 or more of segments III–VII); enlarged, bristle-shaped setae scattered over remainder of surface, largest posteriorly and anteriorly, smallest in center of body; longest seta on segment VII, excluding those surrounding cerarian cluster, 63 μ long (paratypes 57–80 (68) μ), segment IV with 42 setae, excluding those in cerarii (paratypes with 33–48 (42) setae). Trilocular pores absent. Discoidal pores represented by small, irregular sclerotized spots, distributed in same relative abundance as multilocular pores. Multilocular pores scattered over surface, least abundant on posterior portion of abdomen, becoming numerous on abdominal segments I or II, numerous on thorax and head. Oral-collar tubular ducts with inconspicuous collar, unusually short for mealybug, in marginal or submarginal areas of segments V–VII (paratypes with ducts absent or on 1, and some, or all of segments IV–VII). Ostioles small and usually inconspicuous.

Anal ring dorsal, usually touching apex of abdomen, with 7–9 rows of pores; anal-ring setae with acute apices, longest seta 133 μ long (paratypes 125–150 (139) μ), longest seta 1.4 times longer than greatest diameter of ring (paratypes 1.3–1.7 (1.5) times).

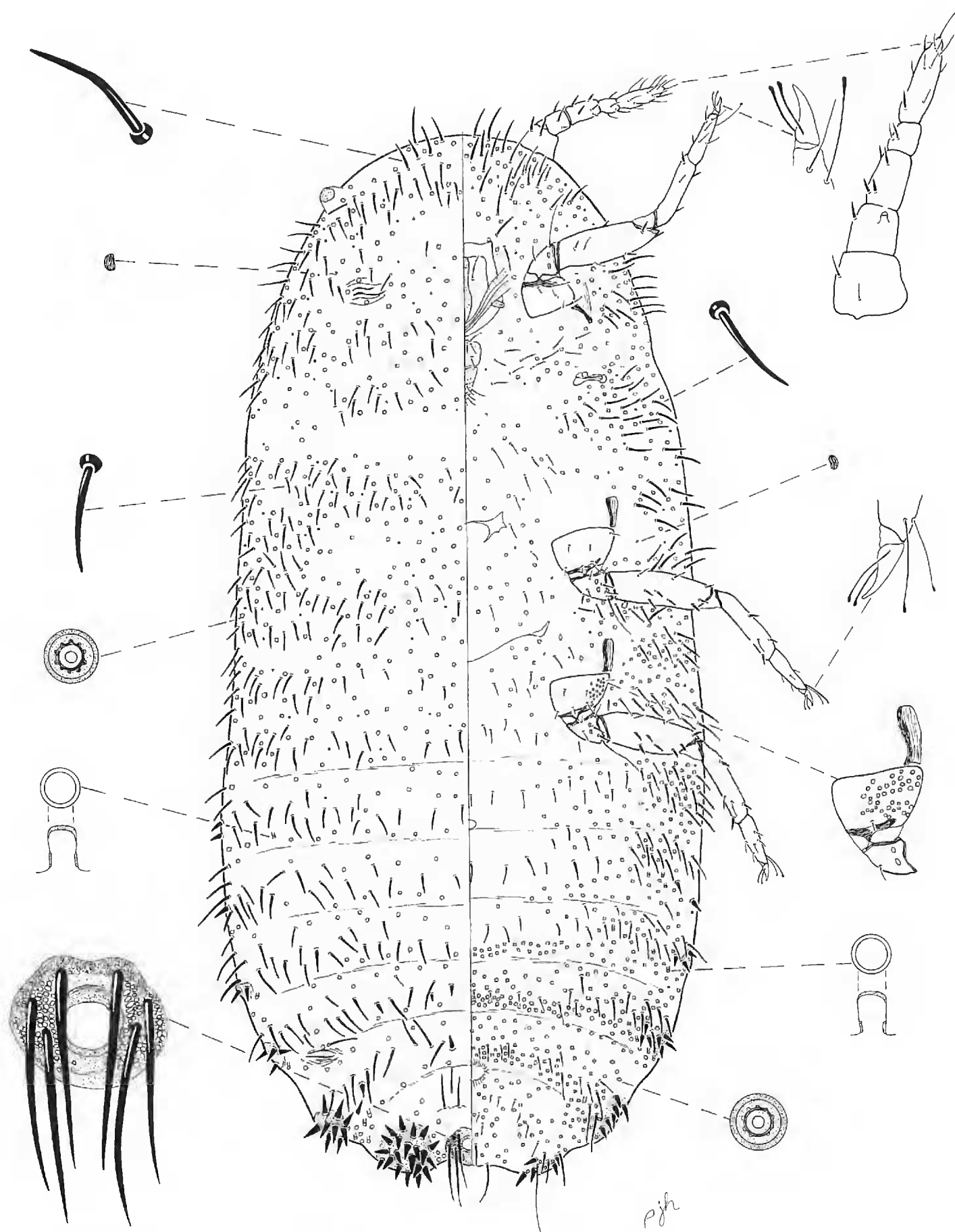


Fig. 6. Adult female holotype of *Hypogeococcus margaretae* n. sp. near Port St. Lucie Co., Florida, XII-17-81, on *Eriocaulon decangulare*.

Venter with 3 kinds of setae; conical setae restricted to marginal and submarginal areas of abdomen; enlarged, bristle-shaped setae in marginal and submarginal clusters except on anterior apex of head, medial setae on segments III-V slightly enlarged; bristle-shaped setae in medial and mediolateral areas of abdomen, thorax, and head, excluding segments III-V, also on anterior apex of head; longest bristle-

shaped seta on segment VII 45 μ long (paratypes 35–50 (42) μ); with 2 pairs of cisanal setae, longest seta 77 μ long (paratypes 60–123 (85) μ); longest anal-lobe seta 170 μ long (paratypes 163–205 (182) μ); length of longest anal-ring seta/length of longest anal-lobe seta 0.8 (paratypes 0.7–0.9 (0.8) units). Multilocular pores abundant over surface, absent or sparse in medial areas of segments II–IV or V. Trilocular pores absent. Discoidal pores of same nature and distribution as on dorsum. Oral-collar tubular ducts of same size and shape as on dorsum, on marginal or submarginal areas of segments II or III–VII (paratypes often with fewer ducts on fewer segments). Ventral anal-lobe area broadly sclerotized, somewhat indefinite anteriorly, apparently with conical setae, bristle-shaped setae, and multilocular pores.

Circulus oval, width/length 1.5 (paratypes 1.3–1.7 (1.5) units) not divided, 25 μ wide (paratype 20–30 (25) μ). Hind legs with 30 and 35 translucent pores on dorsal surface of each coxa (paratypes 30–46 (38) pores), 18 and 26 pores on ventral surface of each coxa (paratypes 20–44 (27) pores); tibia without pores (paratypes without pores on 5 of 10 specimens, when present, located on dorsal surface at distal apex, with 1–6 (3) pores). Hind femora 210 and 213 μ long (paratypes 195–217 (205) μ); tibiae 167–170 μ long (paratypes 147–170 (159) μ); tarsi 93 and 90 μ long (paratypes 80–90 (87) μ); length of femur/tibia 1.3 (paratypes 1.2–1.4 (1.3) units); length of tibia/tarsus 1.8 (paratypes 1.7–1.9 (1.8) units). Tibia with 9 setae (paratypes 8–9 (9) setae). Leg setae bristle shaped except for some setae on trochanter, femur, and tibia as follows: hind trochanter with enlarged bristle-shaped seta on lower-distal portion (as drawn) (paratypes sometimes with 2 enlarged at distal end); hind femur with enlarged, bristle-shaped setae on ventral surface at distal end of segment and posterior edge (as drawn) (paratypes often with setae on anterior edge also enlarged); hind tibia with enlarged, bristle-shaped setae on ventral surface at distal end of segment and along anterior margin (as drawn) (paratypes occasionally with enlarged seta on posterior margin near middle of segment); front legs with few enlarged, bristle-shaped setae on femur (paratypes often with many more enlarged setae on front femur); tarsal digitules usually not quite reaching tip of claw, digitules of hind 2 pair of legs unequal in length, with apical clubs of approximately same size (1 or 2 paratypes with digitules apparently of same length), digitules of front legs unclear (paratypes with front digitules unequal, 1 without apical club, other similar to digitule of hind tarsi); claw digitules extending beyond apex of claw, equal in size, about equal to largest tarsal digitule. Antennae 5-segmented (3 of 10 paratypes with third segment partially divided), 255 and 260 μ long (paratypes 225–260 (245) μ); with enlarged, bristle-shaped setae on anterior margin (as drawn) of segments 1–5 (paratypes on segments 1–3, 4, or 5). Labium with basal segment closely attached to second segment, 87 μ long (80–100 (89) μ). Eye without associated pores.

Comparison.—A comparison is given of the adult females of *Hypogeococcus margaretae* and *H. hamoni* in the treatment of the latter species.

THIRD-INSTAR FEMALE

(Fig. 7)

Specimens examined.—The following description is based on 3 specimens collected near Port St. Lucie, Florida on 28-VII-1982.

Description.—Mounted, 1.1–1.2 (1.2) mm long, 0.5–0.6 (0.5) mm wide. Body elongate.

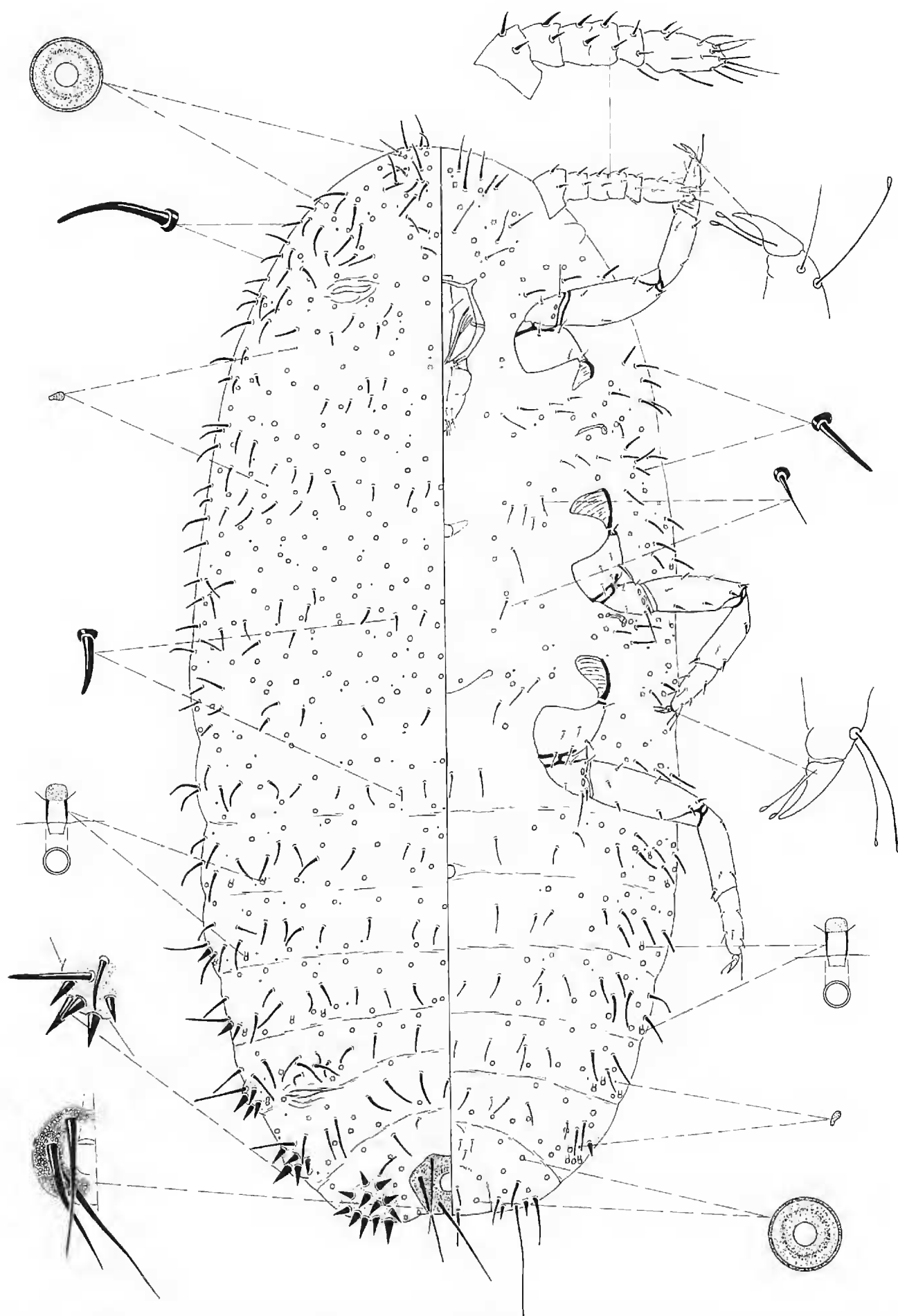


Fig. 7. Third-instar female paratype of *Hypogeococcus margaretae* n. sp. near Port St. Lucie, Florida, VII-28-82, on *Eriocaulon decangulare*.

Dorsum with 4 or 5 (5) pairs of cerarii. Anal-lobe cerarius with basal sclerotization, 12-14 (13) conical setae, 1-3 (2) enlarged, bristle-shaped setae, 1 specimen with 3 discoidal pores, remaining specimens without pores. Penultimate cerarius with basal sclerotization, 6 or 7 conical setae, 1-3 (2) enlarged, bristle-shaped setae, no pores. Antepenultimate cerarius with basal sclerotization, 4-5

(4) conical setae, 0–1 (1) enlarged, bristle-shaped setae, no pores. Fourth cerarius with basal sclerotization, 1–5 (3) conical setae, 0–2 (1) enlarged, bristle-shaped setae, no pores. Fifth cerarius, when present, with 1–3 (2) conical setae, 1–2 (1) enlarged, bristle-shaped setae, no pores. With 1 or 2 kinds of setae; 1 conical seta present on 1 specimen, located dorsomedially on segment VII, absent from remaining specimens; enlarged, bristle-shaped setae scattered over surface; longest seta on segment VII, excluding those surrounding cerarian cluster, 40–49 (45) μ long, segment IV with 19–22 (20) setae, excluding those in cerarii. Trilocular pores absent. Discoidal pores represented by small, irregular sclerotized spots, distributed in same relative abundance as multilocular pores. Multilocular pores present over surface, most abundant on thorax. Oral-collar tubular ducts in marginal or submarginal areas on any or all of segments II–VII. Ostioles small.

Anal ring dorsal, touching apex of abdomen, with 5 or 6 (6) rows of pores; anal-ring setae with acute apices, longest seta 111–119 (115) μ long, longest seta 1.5–1.7 (1.6) times longer than greatest diameter of ring.

Venter with 2 kinds of setae; abdominal segments each with 10 or more setae; enlarged, bristle-shaped setae in marginal and submarginal areas except on head, with 3–5 setae cluster near each lateral margin of each segment; bristle-shaped setae scattered over remainder of surface; longest bristle-shaped seta on segment VII 32–47 (41) μ long; with 2 pairs of cisanal setae, longest seta 52–62 (58) μ long; longest anal-lobe seta 143–148 (145) μ long; length of longest anal-ring seta/length of longest anal-lobe seta 0.8. Multilocular pores most abundant on thorax, usually absent from medial areas of segments I or II to VI or VII. Trilocular pores absent. Discoidal pores of same nature and distribution as on dorsum. Oral-collar tubular ducts on marginal and submarginal areas of metathorax and all or some of segments III to VII. Ventral anal-lobe area broadly sclerotized, with several enlarged, bristle-shaped setae, sometimes with 1 or 2 conical setae, 1 bristle-shaped seta, several multilocular pores.

Circulus oval, width/length 1.1–1.3 (1.2), 17–20 (18) μ wide. Hind legs with trace of translucent pores on coxa; hind femora 138–146 (142) μ long; tibiae 101–109 (105) μ long; tarsi 77–79 (78) μ long; length of femur/tibia 1.3–1.4 (1.3); length of tibia/tarsus 1.3–1.4 (1.4). Tibia with 7 setae. Leg setae bristle shaped except for some enlarged, bristle-shaped setae on trochanter, femur, and tibia; tarsal digitules of hind 2 pairs of legs unequal in length, with apical clubs of approximately same size, digitules of front legs unequal, 1 without club, other similar to digitules of hind tarsi; claw digitules extending beyond apex of claw, equal in size. Antennae 5-segmented, third segment sometimes partially divided, 180–203 (192) μ long; enlarged, bristle-shaped setae on anterior margin (as drawn) of segments 1–3 or 4. Labium with basal segment closely attached to second segment, 77–79 (78) μ long. Eyes without associated pore.

Comparison.—Third instar of *Hypogeococcus margaretae* and *H. boharti* differ by the former having 12–14 (13) conical setae in each anal-lobe cerarius, enlarged, bristle-shaped setae scattered over dorsum, oral-collar tubular ducts absent from head and medial areas, anal ring with 5 or 6 rows of pores, longest anal-ring seta 111–119 (115) μ long, longest cisanal seta 52–62 (58) μ long, longest anal-lobe seta 143–148 (145) μ long, hind femur 138–146 (142) μ long, tibia/tarsus ratio 1.3–1.4 (1.4), tibiae each with 7 setae, some leg setae enlarged, antennae 5-segmented, eye without associated pores; *H. boharti* has 4–5 (4) conical setae in each

anal-lobe cerarius, no enlarged, bristle-shaped setae, oral-collar tubular ducts on head and dorsomedial areas of abdomen, anal ring with 2 rows of pores, longest anal-ring seta 145–170 μ , longest cisanal seta 27 μ long, longest anal-lobe seta 103–115 μ long, hind femur 105–117 (110) μ long, length of tibia/tarsus ratio 1.1, tibiae each with 9 setae, no enlarged leg setae, antennae 6-segmented, eye with associated pores.

Third-instar females of *H. margaretae* can be separated from second-instar females of the same species by having more dorsal setae (segment IV with about 20 setae), more cerarian setae (anal-lobe cerarius with about 13 conical setae), longer anal-lobe setae (about 145 μ long), and length of tibia/tarsus about 1.4; second-instar females have 7 setae on segment IV, 4 or 5 conical setae in each anal-lobe cerarius, anal-lobe setae about 128 μ long, and length of tibia/tarsus about 1.1.

SECOND-INSTAR FEMALE

(Fig. 8)

Specimens examined.—The following description is based on 2 specimens collected near Port St. Lucie, Florida on 28-VII-1982.

Description.—Mounted, 0.9 mm long, 0.4 mm wide. Body elongate.

Dorsum with 5 pairs of cerarii. Anal-lobe cerarius with basal sclerotization, 4 or 5 conical setae, 0 or 1 enlarged, bristle-shaped seta, no pores. Penultimate cerarius with basal sclerotization, 3 conical setae, 0 or 1 enlarged, bristle-shaped seta, no pores. Antepenultimate cerarius with basal sclerotization, 1 or 2 conical setae, 0 or 1 enlarged, bristle-shaped seta, no pores. Fourth and fifth cerarii each with basal sclerotization, 1 conical seta, 1 enlarged, bristle-shaped seta, no pores. With 1 kind of seta; enlarged, bristle-shaped setae scattered over surface, largest posteriorly and anteriorly, smallest in center of body; longest seta on segment VII 37 μ long, segment IV with 7 setae, excluding those in cerarii. Trilocular pores absent. Discoidal pores represented by small, irregular sclerotized spots, present near multilocular pores. Multilocular pores scattered over surface, most abundant anteriorly. Oral-collar tubular ducts in marginal areas on any or all of segments II–VII. Ostioles small.

Anal ring dorsal, touching apex of abdomen, with 4 or 5 rows of pores; anal-ring setae with acute apices, longest seta 89 and 99 μ long, longest seta 1.5 and 1.6 times longer than greatest diameter of ring.

Venter with 2 kinds of setae, abdominal segments each with 6–10 (8) setae; enlarged, bristle-shaped setae in marginal areas on segments III or IV to VII, with 1 seta near each lateral margin of each segment; bristle-shaped setae scattered over remainder of surface; longest bristle-shaped seta on segment VII 25 μ long; with 2 pairs of cisanal setae, longest seta 25 and 32 μ long; longest anal-lobe seta 126 and 131 μ long; length of longest anal-ring seta/length of longest anal-lobe seta 0.7 and 0.8. Multilocular pores most abundant on thorax, absent from medial areas of segments IV or V to VIII. Trilocular pores absent. Discoidal pores of same nature and distribution as on dorsum. Oral-collar tubular ducts on marginal or submarginal areas of metathorax and all or any of segments V–VII. Ventral anal-lobe area sclerotized, with enlarged, bristle-shaped setae.

Circulus oval, width/length 1.2 and 1.3, 12 μ wide. Hind legs without translucent pores. Hind femora 103 μ long; tibiae 74 μ long; tarsi 67 and 69 μ long; length

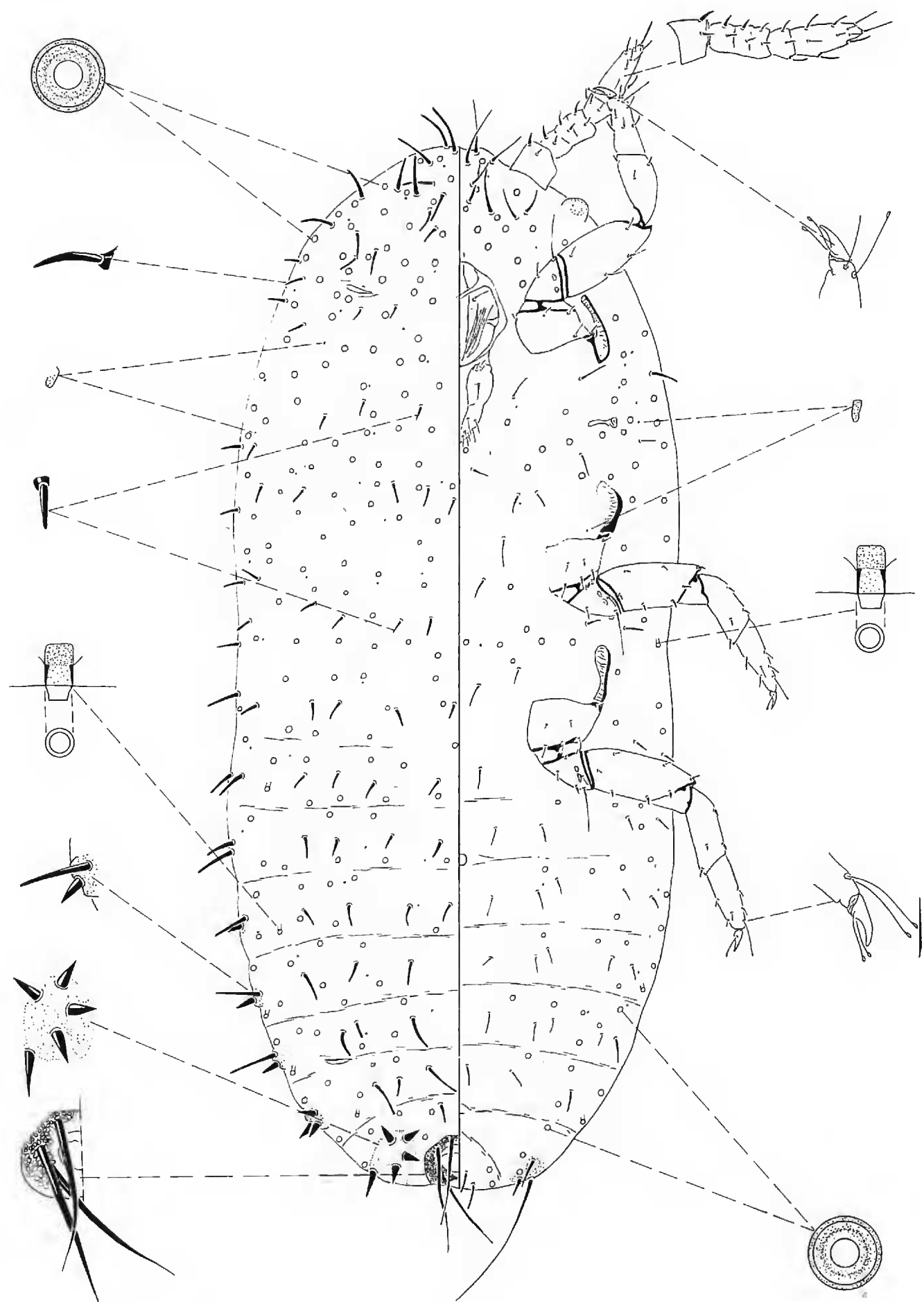


Fig. 8. Second-instar female paratype of *Hypogeococcus margaretae* n. sp. near Port St. Lucie, Florida, VII-28-82, on *Eriocaulon decangulare*.

of femur/tibia 1.4; length of tibia/tarsus 1.1. Tibia with 7 setae. Leg seta bristle shaped except for some enlarged, bristle-shaped setae on femur, tibia, and sometimes trochanter and tarsus; tarsal digitules reaching tip of claw, digitules of hind 2 pairs of legs subequal in length, with apical clubs of approximately same size,

digitules of front legs unequal, 1 without club, other similar to digitule of hind tarsi; claw digitules extending beyond apex of claw, equal in size. Antennae 5-segmented, third segment partially divided, 160 and 168 μ long; enlarged, bristle-shaped setae on anterior margin (as drawn) of segments 1-3 or 4. Labium with basal segment closely attached to second segment, 67 μ long. Eyes without associated pores.

Comparison.—Second instars of *H. margaretae* can be separated from first instars of the same species by having 4 or 5 conical setae in each anal-lobe cerarius, 4 dorsal setae on segment IV, no trilocular pores, many multilocular pores, and marginal oral-collar tubular ducts; first instars have 2 conical setae in each anal-lobe cerarius, 7 dorsal setae on segment IV, many trilocular pores, and no multilocular pores or oral-collar tubular ducts.

For a comparison of second-instar males and females of *H. margaretae* see the comparison section of the second-instar male. For a comparison of third-instar and second-instar females, see the comparison section of the third-instar female.

SECOND-INSTAR MALE

Specimen examined.—The following description is based on 1 specimen collected near Port St. Lucie, Florida on 28-VII-1982.

Description.—Second-instar males are very similar to second-instar females. Only differences are given here.

Dorsum with 4 or 5 pairs of cerarii. Anal-lobe cerarius with 2 conical setae, 3 enlarged, bristle-shaped setae. Penultimate cerarius with 2 conical setae, no bristle-shaped setae. Remaining 2 or 3 cerarii each with 1 conical seta and 1 enlarged, bristle-shaped seta. Longest seta on segment VII 35 μ long. Oral-collar tubular ducts in marginal and mediolateral areas of most of surface.

Anal-ring with longest seta 79 μ long, longest seta 1.5 times longer than greatest diameter of ring.

Venter with longest bristle-shaped seta on segment VII 25 μ long; longest cisanal seta 30 μ long; longest anal-lobe seta 148 μ long; length of longest anal-ring seta/length of longest anal-lobe seta 0.5. Oral-collar tubular ducts on marginal areas from head to thorax.

Circulus width/length 1.2, 12 μ wide. Hind femora 99 μ long; tibia 72 μ long; tarsus 62 μ long; length of tibia/tarsus 1.2. Antennae 6-segmented, 151 μ long. Labium 64 μ long.

Comparison.—Male and female second instars can be distinguished by the former having fewer conical setae in the hind 2 pairs of cerarii, more oral-collar tubular ducts scattered over most of the dorsum, and by having 6-segmented antennae.

FIRST INSTAR (Fig. 9)

Specimen examined.—The following description is based on 1 first instar paratype from near Port St. Lucie, Florida collected 28-VII-1982 and 8 embryos that are inside 3 of the 4 adult female paratypes collected in Jackson Co., Mississippi.

Description.—Only salient features are included because of the poor condition of the available material.

Mounted, 380-632 (445) μ long, 187-304 (219) μ wide. Body elongate oval.

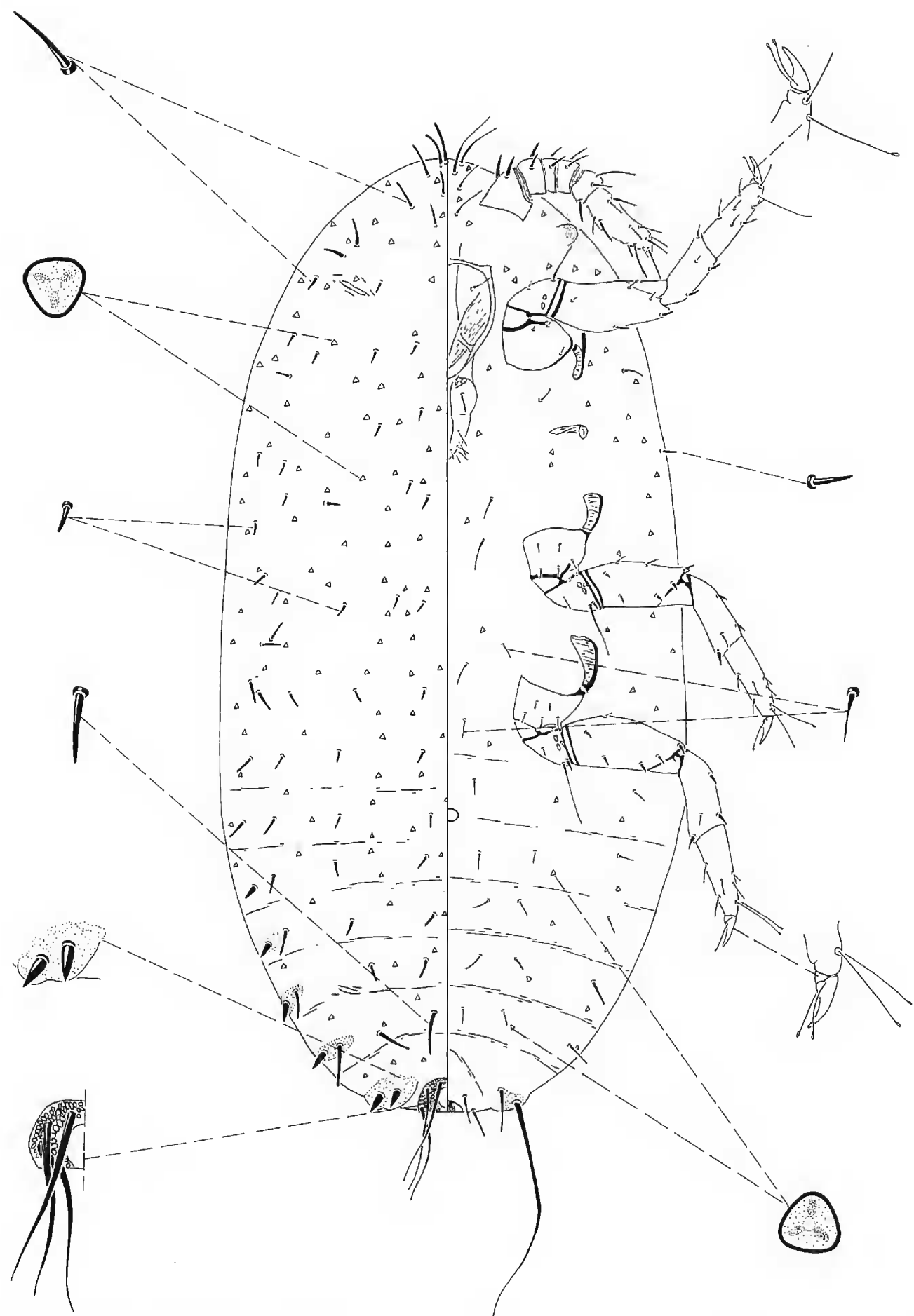


Fig. 9. First-instar paratype of *Hypogeococcus margaretae* n. sp. near Port St. Lucie, Florida, VII-28-82, on *Eriocaulon decangulare*.

Dorsum with 4–7 (5) pairs of cerarii that have at least 1 conical seta, with about 12 paired, enlarged bristle-shaped setae along each body margin in form of cerarii including those with conical setae; cerarii without associated pores, with basal sclerotization. Anal-lobe cerarii with 2 conical setae; penultimate cerarii with 1–2 (2) conical setae and 0–1 (0) enlarged, bristle-shaped setae; antepenultimate and

fourth cerarii each with 1-2 (1) conical setae and 0-1 (0) enlarged, bristle-shaped setae; fifth cerarii with 0-1 (1) conical setae and 1-2 (1) enlarged, bristle-shaped setae; sixth and seventh cerarii each with 0-1 (0) conical setae and 1-2 (2) enlarged, bristle-shaped setae; remaining cerarii each with 2 enlarged, bristle-shaped setae. With 2 kinds of setae; conical setae restricted to cerarii except 1 specimen has 1 such seta in medial area of segment 5; enlarged, bristle-shaped setae scattered over dorsum, arranged in 4 longitudinal lines on most of abdomen, excluding setae in cerarii, with extra setae on thoracic segments, shortest setae in center of body; longest seta on segment VII, excluding those in cerarii, 23-32 (27) μ long, segment IV with 4 setae including those in cerarii. Trilocular pores scattered over surface most abundant on thorax, on abdomen usually with 6 longitudinal lines of pores with transverse row of pores located near anterior and posterior margin of each anterior abdominal segment, forming 6 or 8 longitudinal lines of trilocular pores on abdomen. Discoidal and multilocular pores absent. Tubular ducts absent. Ostioles present.

Anal ring apical, with 3 or 4 rows of pores; anal-ring setae with acute apices, longest seta 63-77 (71) μ long.

Venter with 2 kinds of setae, forming 6 longitudinal lines of setae on abdomen; enlarged, bristle-shaped setae restricted to submarginal areas of posterior 2 or 3 abdominal segments; bristle-shaped setae on rest of surface; longest bristle-shaped setae on segment VII about 20 μ long; with 2 pairs of cisanal setae; longest anal-lobe seta 87-151 (124) μ long. Trilocular pores associated with submarginal and mediolateral lines of setae on abdomen, scattered on thorax and head. Multilocular and discoidal pores absent. Tubular ducts absent. Ventral anal-lobe area sclerotized.

Circulus oval, not divided, 7-11 (9) μ wide. Legs generally unclear on embryos, on single available crawler hind femora each 79 μ long; tibiae each 59 μ long; tarsi 62 and 59 μ long; length of femur/tibia 1.3; length of tibia/tarsus 1.0. Tibia with 7 setae; leg setae bristle shaped except for some enlarged setae on trochanter, femur and tibia; tarsal digitules of hind 2 pairs of legs about equal in size, extending beyond apex of claw, of front pair of legs, each tarsus apparently with 1 long, capitate digitule and 1 short, apically acute digitule; claw digitules equal, extending beyond tip of claw. Antennae unclear on embryos, on single crawler 6-segmented, each 133 μ long; with enlarged, bristle-shaped setae on anterior margin (as drawn) of segments 1-3 or 4. Labium with basal segment closely attached to second segment, about 50 μ long. Eye without associated pores.

Comparison.—First instars of *Hypogeococcus margaretae* and *H. boharti* differ as follows: *H. margaretae* lacks a trilocular pore between the conical setae of the anal-lobe cerarius, has enlarged, bristle-shaped setae, has 2 transverse rows of trilocular pores on anterior abdominal segments, lacks ventral discoidal pores, has enlarged, bristle-shaped setae on the femora and tibiae, and lacks a discoidal pore associated with the eye; *H. boharti* has a trilocular pore between the conical setae of the anal-lobe cerarius, lacks enlarged, bristle-shaped setae, has only 1 transverse row of trilocular pores on abdominal segments, has a line of discoidal pores on the venter near the base of the submarginal setae, lacks enlarged setae on the legs, and has a discoidal pore associated with each eye. For a comparison of second instars of *H. margaretae* with first instars of the same species see the comparison section of the second-instar female.

DISCUSSION

During the course of this study special emphasis was devoted to several characters that previously were given little or no detailed study. These characters included numbers of leg setae (i.e., number of setae on hind tibia), numbers of setae on the abdomen (i.e., number of setae on the dorsum of segment IV), lengths of the abdominal setae (i.e., lengths of dorsal and ventral setae on segment VII and of the cisanal setae), numbers of cisanal setae, and relative sizes of the claw and tarsal digitules. Each of these characters has proven to be of value in distinguishing among species of *Hypogeococcus* and may be useful in other groups of mealybugs. Characteristics of the digitules were especially interesting. Features of digitules have been used in the genus *Rhizoecus* (Hambleton, 1976) and seem to characterize genera of the tribe Phenacoccini (Miller, 1975). In all of the species of *Hypogeococcus*, and in *Ferrisia virgata* (Cockerell), *Nipaecoccus nipae* (Maskell), *Paradoxococcus mcdanieli* McKenzie, *Planococcus citri* (Risso), *Pseudococcus maritimus* (Ehrhorn), *Trionymus winnemucae* McKenzie, and probably most mealybugs, the front legs have asymmetrical tarsal digitules, with one digitule on each leg capitate and with the other digitule bristle shaped and without an enlarged apex. Both tarsal digitules of each of the mesothoracic and metathoracic legs usually are capitate, although one usually is much more robust than the other. The claw digitules usually are larger than the tarsal digitules and frequently are equal in size on all three pairs of legs. The study of embryos has proven to be of considerable value in learning about the morphology of the first instars of 2 *Hypogeococcus* species and may prove to be of use in other pseudococcid studies. Embryos have been used in armored scales (Miller *et al.*, in press) and have the added advantage of giving a clear association with an adult female.

Studies of immature forms continue to provide interesting and valuable information relative to the formulation of a usable mealybug classification. The occurrence of trilocular pores on the first instars of *Hypogeococcus* is somewhat surprising in light of the fact that *Heterococcus*, another genus of mealybug that lacks trilocular pores as adults, has only quinquelocular pores in first instars (Miller, 1975). Study of second instars of *Hypogeococcus* support the hypothesis that in most mealybugs, the second-instar male has more oral-collar tubular ducts than does the second-instar female.

It is clear that after current research on South American species is complete and adult males and first instars have been studied, the composition of *Hypogeococcus* will need to be reevaluated. It is likely that *Hypogeococcus* eventually will be divided into two or three genera.

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